

1 **COMPUTER USER INTERFACE ARCHITECTURE WHEREIN USERS**
2 **INTERACT WITH BOTH CONTENT AND USER INTERFACE BY ACTIVATING**
3 **LINKS**

4

5 **TECHNICAL FIELD**

6 This invention relates generally to computer user interface architectures. More
7 particularly, the invention provides a user interface architecture in which both user content
8 and user interface are composed of document pages with links.

9 **BACKGROUND OF THE INVENTION**

10 Many personal computer users find the desktop metaphor of prior art computer user
11 interfaces (“UIs”) confusing and difficult to learn. Accordingly, there is a need for a
12 system that simplifies the user’s interaction with the computer by using fewer kinds of user
13 interface controls in a more general way.

14 Further, the ways in which users interact with information about prior UIs is
15 different than the way the user interacts with content, such as documents, presentations,
16 and the like. For example, in prior art UIs, content and UI information are displayed
17 entirely differently. Content is typically displayed in a particular region or frame of the
18 display. User interface information is never displayed there. Instead, user interface
19 information is displayed in dialog boxes, drop down menus, and tool bars. User content
20 never shows up in dialog boxes, drop down menus, and tool bars. Similarly, users find
21 user content documents and UI help information differently. Accordingly, there is a need
22 for a UI architecture in which the concepts and actions the user must learn are the same for
23 interacting with both content and the UI. Such a unification makes computer software
24 easier and more efficient to use.

25 Prior art UIs for desktop computers typically require a keyboard and mouse in
26 order for a user to interact with them, and most pen-enabled palmtop computers have
27 cumbersome means of interaction. Therefore, there is a need for more “natural” styles of
28 interacting with a computer by using a minimum number common gestures such as touch,
29 hold, erase, draw or write.

30 Prior art UI desktop metaphors applied to small form factor devices are typically
31 cluttered and difficult to use. In addition, applications that provide rich functionality are

1 sometimes constrained by the limited ability of a user to navigate menus and dialogs of
2 prior art UIs. For instance, for such applications, the menus and tool bars may get too big,
3 and the help system may get too cumbersome to navigate or search. Accordingly, in
4 addition to the need for a simpler more unified experience for the user of an application,
5 there is also a need to facilitate the uncluttered presentation of user interfaces for
6 applications providing very rich functionality.

7 Usability data for prior art UIs show that users of multi-windowed systems don't
8 always know which actions will produce results in which window. Therefore, there is a
9 need to reduce the complexity and confusion sometimes caused by multi-windowed user
10 interfaces.

11 Prior art UIs typically offer limited capabilities for customizing the UI.
12 Accordingly, there is a need for a UI architecture that provides greater flexibility to users,
13 content developers, and third-party software developers by providing broader capabilities
14 for easily customizing the UI. For example, different groups of users may be of different
15 levels of computer skill and have need of different sets of features, and the UI can be
16 customized to better suit their needs.

17 Users of prior art UIs sometimes become extremely frustrated when their work is
18 lost because their work was not properly saved. Accordingly, there is a need to provide a
19 save-less model, so that users do not need to explicitly save their work.

20 Users of prior art UIs typically do not have a convenient and seamless way to
21 record notes verbally and to associate notes with particular parts of a document.
22 Accordingly, there is a need to provide rich support for audio note taking with the ability to
23 correlate and synchronize audio and textual material and to review and retrieve audio
24 notes.

25 Prior art device-to-device and device-to-PC synchronization schemes typically are
26 not seamless and require a great deal of configuration and attention from the user.
27 Accordingly, there is a need to provide automatic and transparent synchronization between
28 a user's computers, such as a handheld computer and a desktop computer.

29 In prior art UIs, methods for getting help are currently separate from the content
30 and often require completely different interactions than interacting with content.

1 Accordingly, there is a need to make the process of getting help about a function the same
2 as the process for carrying out the function.

3 Prior art UIs typically have a “single-user model” at the heart of their interface
4 metaphors, which makes sharing content and annotations with other users difficult and
5 non-intuitive. Accordingly, there is a need to make sharing and collaborating on
6 documents easier and more automatic.

7 **SUMMARY OF THE INVENTION**

8 According to various preferred embodiments, the invention includes a user
9 interface architecture in which user content and user interface are composed of documents
10 with links. A link can relate a spot or region in a document with a spot or region in another
11 document, so that touching the link causes the display to navigate to that other document.
12 A link can also relate a spot or region in a document and an active runnable object such that
13 when a user activates that link or touches that spot in the document, the associated object is
14 run. Parameters for the execution of the object may be supplied by properties associated
15 with the link. Links, therefore, can act as commands. Links may be to any kind of
16 command code.

17 A link may manifest in various ways based on the link’s properties. Links can look
18 like not only clickable spots, but also fill-in fields and other kinds of well-known and later-
19 developed user interface elements. Alternatively, links can manifest in the containing
20 document a frame displaying the contents of part, or all, of the linked-to document. When
21 links are displayed, in addition to basing the display format of the link on the link’s display
22 properties, the link display format may depend upon the characteristics of the linked-to
23 document.

24 The path a user takes to reach a document typically affects the behavior and
25 presentation of the document. State-like information for displaying a linked-to document
26 page is stored separately from the linked-from and linked-to documents as part of the
27 link’s properties. Users access, interact with, and navigate among both user content
28 documents and user interface documents in a unified way, namely, by activating links.
29 Further, both user content document pages and user interface document pages are
30 displayed in a single viewing frame. This unified approach simplifies the user’s

1 interaction with both user content and user interface documents by reducing the number of
2 concepts a user must learn in order to access, interact with, and modify both user content
3 documents and the user interface.

4 A non-linear navigation history is maintained such that a user can navigate along a
5 first path, back up using a previous link an appropriate number of times, navigate along a
6 second path, back up along the second path using the previous link an appropriate number
7 of times, and re-navigate along the first path again using a next link. Every document page
8 to which a user navigates is saved in the user's navigation history. Users can query their
9 navigation histories and view their navigation history in various ways, such as: by time, by
10 appearance, by site, document, section, page, and the like. User can also view their
11 navigation history as nodes with side tracking branches, as a linear list, or as a combination
12 of most recently viewed pages and last few task categories. According to a preferred
13 embodiment, navigation from user content pages through user interface pages that results
14 in a command being executed is automatically removed from the user's view of the
15 navigational history in order to keep the navigational history view uncluttered.

16 A flexible selection model is supported allowing users to select the object of a
17 command either before or after the command itself is selected. This flexible selection
18 model allows UIs built according to the principles of this invention to scale to small
19 display areas. UIs built according to the principles of this invention also scale well to
20 applications having voluminous and/or complicated user interfaces by facilitating an
21 organized and uncluttered view of the user interface command hierarchy and/or user
22 interface help information for such applications.

23 Users get at commands by navigating to a page where the desired command is
24 found. In a preferred embodiment, the documents-with-links UI according to the
25 principles of this invention is organized to make frequently used commands a single
26 navigation step away, or through customizations, no steps away. A self-explanatory
27 document, the Guide Book is provided. The Guide Book is a readable manual that users
28 can go through in a logical order, a page at a time, like any conventional user manual.
29 Each command mention, however, is an active command instance that can be invoked in
30 place.

1 Other features and advantages of the invention will become apparent through the
2 following description, the figures, and the appended claims.

3

4 **BRIEF DESCRIPTION OF THE DRAWINGS**

5 FIG. 1 is a schematic diagram of a conventional general-purpose digital computing
6 environment that can be used to implement various aspects of the invention.

7 FIG. 2 shows a conventional tablet and stylus-based computer that can be used to
8 implement various aspects of the invention.

9 FIG. 3 is a flowchart showing simplified steps at a high level of abstraction for
10 implementing a UI architecture according to the principles of this invention upon start up.

11 FIG. 4 is a flow chart showing simplified steps for implementing the “display state”
12 step of the flow chart in FIG. 3.

13 FIG. 5 depicts an example Start Page displayed on a personal viewer according to a
14 preferred embodiment of the invention.

15 FIG. 6 depicts an example book cover page and table of contents displayed on a
16 personal viewer according to a preferred embodiment of the invention.

17 FIG. 7 depicts example Guide Book pages displayed on a personal viewer
18 according to a preferred embodiment of the invention.

19 FIG. 8 depicts example Quick Help pages, one of which is bookmarked, displayed
20 on a personal viewer according to a preferred embodiment of the invention.

21 FIG. 9 depicts an example of a pinned user content page displayed on a personal viewer
22 according to a preferred embodiment of the invention.

23 FIG. 10 depicts an example of inked annotation displayed on a personal viewer
24 according to a preferred embodiment of the invention.

25 FIG. 11 depicts an example End Page displayed on a personal viewer according to
26 a preferred embodiment of the invention.

1 **DETAILED DESCRIPTION OF THE INVENTION**

2 **Table Of Contents For The Detailed Description Section**

3 Introduction.....	7
4 Clutter-Free And Simple.....	7
5 Content And UI Are Unified.....	8
6 Shortcuts	8
7 Scalability To Various Display Sizes And Types.....	8
8 General Concepts Underlying The Documents-With-Links UI Architecture	9
9 No Distinction Between Content Documents And UI Documents.....	9
10 Links As Commands And Link Properties	10
11 Guide Book	11
12 Rich Navigation And Maintaining The User's Navigational History	12
13 Flexible Selection Model.....	16
14 Page Display Depends Upon The Link Used To Navigate To The Page	16
15 Modeless UI.....	17
16 Creating And Saving Information.....	18
17 Example Hardware Platforms For Implementing Aspects Of The Invention.....	19
18 Example Steps For Implementing Aspects Of The Invention	21
19 Preferred Embodiments of the UI Architecture for a Personal Viewer	22
20 Personal Viewer UI Elements	22
21 Personal Viewer Display Modes.....	26
22 Gestures For Performing PV UI Actions	27
23 Navigating.....	28
24 Hyperlinking	28
25 Next And Previous Commands.....	29
26 Scrolling Is Possible.....	29
27 Users Can Create Links	30
28 Links	30
29 Displaying Links.....	30
30 Link Property Sheet	31

1	Customizable UI	33
2	Users Can Place Links In UI.....	33
3	Page Pinning	33
4	Navigating Documents/Link Properties.....	35
5	Viewing History.....	35
6	Applies To UI	35
7	Non-Linear Navigation History	36
8	Annotations.....	37
9	Making Annotations.....	37
10	Storing Annotations.....	37
11	Interface Shortcuts and Smarts	38
12	Most-Likely-To-Use-Links and Other Heuristics.....	38
13	Frequently Used Links	38
14	Start Page	39
15	User Can Modify Start Page	39
16	Audio Recording and Annotation	39
17	Guide Book	40
18	Obtain Help And Perform Functions In The Same Way	40
19	Concluding Remarks.....	41

Introduction

Clutter-Free And Simple

The UI architecture of this invention, also referred to herein as a “documents-with-links UI,” supports creation of UI’s that have essentially zero clutter, and few concepts to master. In this way, it is a major departure from prior art UI’s using a desktop metaphor. The user of a documents-with-links UI according to this invention focuses primarily on content and not on UI appurtenances. Starting with just knowledge of how to page through a document and to follow links, a user can learn how to do any other UI operation. Significantly, the documents-with-links UI works without drop-down menus, toolbars, windows, or other cluttering UI elements (although some of these elements may optionally be made available where they are desired)

1 **Content And UI Are Unified**

2 In the UI architecture of this invention there is essentially no distinction between
3 UI pages and content pages. “UI” and “content” are the same thing, and exist in the same
4 navigation space. As described in more detail below, smart next/previous logic and
5 intelligent management of the navigation chain solve technical problems caused by treating
6 “UI” and content as the same thing in a unified navigational context.

7 Because there is no seam between UI and content, no notion of “dual” spaces, the
8 documents-with-links UI is conceptually simpler for the user than a model that has
9 separate UI and content webs. The one-space model is also more powerful and
10 customizable, as described in more detail below.

11 **Shortcuts**

12 Numerous UI shortcuts and direct manipulations may exist as a configurable layer
13 on top of the documents-with-links UI, so more experienced users can do the most
14 common operations in context, without navigating to UI pages. The user gets the best of
15 terse command access plus the richness of the full browser and answer system for
16 exploring the command set.

17 The documents-with-links UI uses a web architecture, with UI shortcuts layered on
18 top. A naïve user will typically start by using the documents-with-links UI without the
19 shortcuts—that is, by using the Guide Book to access UI functions. An advanced user will
20 typically be able to perform all common operations via the shortcuts and without resorting
21 to the documents-with-links UI Guide Book as often.

22 **Scalability To Various Display Sizes And Types**

23 Various preferred embodiments of the documents-with-links UI will be explained
24 below in the context of a portable “personal viewer” platform. Nevertheless, the
25 documents-with-links UI is scalable across a wide range of device and display types from
26 desktop computers to laptops to hand-held devices. Accordingly, the documents-with-
27 links UI is intended to be implemented on any type of computing platform. The
28 documents-with-links UI exploits a large screen by being able to show content in a book-
29 like way--two full side-by-side pages, as depicted, for instance, in FIG. 8. UI, being
30 content, takes advantage of the large format of pages and the ability to turn/navigate pages

1 (versus the smaller size of menus/dialog boxes in prior art UIs and their limited or
2 nonexistent provisions for navigation).

3 At the other end of the spectrum, the UI scales to small screens because of the
4 flexible selection model that allows command selection regions to be initiated either before
5 or after the desired command is chosen. This means, for example, that on a small screen a
6 user can call up a page of command choices that completely obscure the original document
7 due to screen size limitations, choose the command, then return to the user document and
8 then select the region for the command to operate on. Suppose a user wanted to reformat
9 some text, but had not selected the text to be reformatted yet. The user could press a link
10 that indicates that it will reformat text. The UI of this invention will display an indicator
11 on the screen prompting the user to select the text to be reformatted. After selecting the
12 text, the user can finish the reformatting operation by clicking on another link, such as a
13 link that indicates that the selected text will be reformatted. Alternatively, the user could
14 select the region first and then go find and invoke the command. Being able to select the
15 object upon which a command will operate after selecting the command is unlike the
16 selection model of prior art UIs where object selection must precede command selection.
17 The selection model of the documents-with-links UI is discussed in more detail below.

18 **General Concepts Underlying The Documents-With-Links UI Architecture**

19 **No Distinction Between Content Documents And UI Documents**

20 The basic principle of the documents-with-links UI is that everything the user sees
21 and interacts with is a document. This applies equally to both content and UI. These
22 documents could be implemented in HTML, XML, and the like. There is essentially no
23 difference between content and UI documents. In fact the same document can mix content
24 and UI. Even though some UI elements like context menus and toolbars may be presented
25 in ways that do not look document-like, they are in fact implemented as documents and
26 can be manipulated as such.

27 The uniform treatment of content and “UI” pages is important for several reasons:

28 • Users only need to deal with one set of navigation controls and conventions, and
29 only one navigation space. Users never need to think about whether they are in
30 content space or UI space.

- Users can use the full power of the UI to manipulate the UI itself. For example, users can search, annotate, customize and edit UI pages the same as any content (subject to permissions). Users can select from multiple views for the page being viewed.
- The model naturally accommodates dynamic content, including downloaded content, that mixes content and UI on the same page or as part of a network of related pages.

Links As Commands And Link Properties

A link can be an association between two different spots in a collection of document pages. The spots could be two spots on the same page. The spots could be a spot on one page and a spot on another page. Links can have properties that indicate certain things about the link beyond simply the fact that it relates two different places. What a link relates need not necessarily always be displayable pages. A link can relate a spot in a document and an active runnable object such that when a user activates that link or touches that spot in the document, the associated object is run. Links, therefore, can act as commands. Links may be to any kind of command code. Scripts are one example. Binary code objects are another example. As a result, pages that have links replace the drop-down menus and dialog boxes of prior art UIs.

A link may manifest in various ways based on the link's properties. Links can look like not only clickable spots, but also fill-in fields and other kinds of well-known and later-developed user interface elements. A document page could have these other kinds of active elements that are really a form of link. Accordingly, activating links goes beyond merely clicking on colored underlined text and can include filling in fields, pressing radio buttons, and the like. Again, pages with links replace prior art dialog boxes having buttons and the like. The links may look like buttons, but the links are simply links.

Even the desktop metaphor of files and folders is expressed as lists of links on a page. Additionally, links have properties that govern their appearance and behavior. For example, a link's properties may dictate that it appear as a blue underscored text string as in prior art browsers, or as a 3D button, as a graphic icon, as a thumbnail image of the

1 content being linked to, or even as an embedded frame that is open on the content being
2 linked to.

3 As described in more detail below, a user can modify how a link manifests by
4 modifying the link's properties. The ability to control a link's appearance and behavioral
5 properties makes possible rich authoring and customization of both content and the user
6 interface.

7 Actions in a UI according to the principles of this invention occur by clicking on
8 commands that exist on pages. To the user, a command looks like a link, and in fact it is a
9 link. Specifically, a command is a link whose source anchor is the command hotspot,
10 whose destination anchor is the script or code that implements the command, and whose
11 properties are the command parameters. Some commands may run with canned
12 parameters while others may present users with a form for entering the parameters (for
13 example, the Properties command).

14 Because a command is a link, it has all the functionality of links. For example,
15 commands can visualize in multiple ways, such as an underlined blue label, a button, an
16 icon, or a graphic image. They can be copied from one place to another, moved, and
17 deleted. Their properties can be manipulated, such as to change their appearance or to
18 preset some or all of their parameters. Commands can also be created the same way that
19 any kind of link is created, via a Link command, which establishes a link between a source
20 and destination that the user specifies; in the case of creating a command link, the
21 destination is an executable object such as a command script or binary. Everything users
22 can do to a link, or to objects in general (since a link is an object), users can do to
23 commands.

24 **Guide Book**

25 Users get at commands by navigating to a page where the desired command is
26 found. The documents-with-links UI is organized to make frequently used commands a
27 single navigation step away, or through customizations, no steps away. Less commonly
28 used commands may take more steps to get to.

29 The documents-with-links UI includes a self-explanatory document, the Guide
30 Book. This is literally a readable manual that users can go through in a logical order, a

1 page at a time, like any current user manual. The difference is that each command mention
2 is an active command instance that can be invoked in place. A variety of Quick Help
3 pages and indices make it easy to get quick access to sets of commands that are commonly
4 used together, that are logically related, or that are typically used as part of a given
5 scenario. Such Quick Help pages could be assembled dynamically based upon the context
6 of the document or documents being viewed by the user.

7 Users can also use search to find commands. This could call into play an
8 intelligent user assistant or other conventional help mechanisms when appropriate.

9 Even if all commands were only one navigational hop away, however, the
10 documents-with-links UI would not be ideal, because users want the most common
11 commands to be zero hops away. Users also want context sensitivity to command
12 presentation, like that provided by conventional context menus. The documents-with-links
13 UI therefore accommodates things like toolbars, context menus, and other UI shortcuts that
14 the user can customize. Like everything else in the documents-with-links UI, shortcuts are
15 implemented as documents with links. The UI shortcuts can be conceptualized as being
16 layered on top of the base documents-with-links UI, yet shortcuts are actually constructed
17 out of the same components that comprise the documents-with-links UI: documents with
18 links.

19 As a user looks up commands from the Guide Book, the user will learn short cuts
20 so that the more a user interacts with the UI, the less often the user will typically need to
21 navigate to the Guide Book. Therefore, shortcuts will be discussed below, with reference
22 to a preferred embodiment of this UI architecture implemented on a personal viewer, as the
23 shortcuts would appear to a user, because, eventually, shortcuts are what most users would
24 use in their day-to-day activities with the documents-with-links UI.

25 **Rich Navigation And Maintaining The User's Navigational History**

26 When a user performs a navigation action, a record is created of where the user
27 navigated to and at what date and time this occurred. It is thus possible to query this set of
28 records to derive many views of a user's navigational history, including, for instance, a
29 network view, also referred to as a history map view. Ways in which a user's navigational
30 history may be viewed are discussed in more detail below in the Viewing History section.

1 The history map view is a generalization of the linear history provided by prior art
2 browsers. The history map view makes it easy for a user to revisit a place the user visited
3 previously, with important cues about the context in terms of other places the user was
4 visiting at the time. The Next command works with the branching history too. A user can
5 explore a chain of links, back up, explore a different chain, back up, and Next the user's
6 way down the original chain to get back to where the user was. This is much easier than
7 having to manually re-follow the original chain of links, which would be impossible if the
8 user has forgotten the chain of links they had previously followed

9 This is an important extension of the prior art browsing metaphor. Unlike prior art
10 browser UIs with their linear navigation chain, the documents-with-links UI doesn't forget
11 all the twists and turns of where the user has been just because the user backs up and
12 proceeds in a different direction. The documents-with-links UI stores not only where the
13 user has been, but also the path(s) the user took to get there. The user can use the history
14 map and/or the Next/Previous commands to get back there again.

15 The Next function works in this network-style navigational context by using
16 heuristics to pick which path forward the user most likely intends. The most basic rule is
17 to pick the forward path along which the user backed to the current node. Other rules
18 provide additional intelligence to account for a user's known navigational patterns, such as
19 whether the user got to the current node by navigating back by individual pages or by
20 groupings of pages (such as by site), or by linking from a parent to a child. The Next
21 function could include options to present a user with a list of forward choices, textually
22 and/or as a map in which the user could zoom into desired areas. In this way, the user can
23 control which branch to take, if the user is not satisfied with the documents-with-links UI's
24 selection.

25 Part of what makes the navigation and context trimming heuristics possible is built-
26 in knowledge of logical levels of information grouping. For example, the documents-with-
27 links UI can include knowledge of collections of pages making up sections and chapters, of
28 collections of sections and chapters making up a document, of collections of documents
29 making up web sites, and so on. The same is true for the layers of command finding and
30 invocation. Such knowledge of semantic clustering helps guide decisions about popping

1 contexts and for presenting the user with reasonable choices about points to jump to along
2 the Next/Previous chain.

3 A problem with treating content and UI as part of the same navigation space is that
4 the user's navigation chain gets cluttered with UI-related pages. The documents-with-links
5 UI solves that through intelligent management of the navigation context, and by making
6 that context a true network, not just a linear chain.

7 Specifically, when a user navigates from one place to another, a new branch in the
8 navigation chain is started. So, if a user's context is currently B in the existing chain of
9 document pages A-B-C, and the user navigates to D, then the new context is D. D might
10 be a UI page the user navigated to from document B. When the user clicks a command on
11 page D, the command executes and removes D from the navigation context. Thus, after
12 finding and executing the command, the user's navigation context is restored to document
13 page B.

14 To find a needed command the user might have to navigate along a chain from D to
15 several other pages in the Guide Book, resulting in a chain of several steps branching off
16 from B. When the user finally picks a command, the documents-with-links UI knows what
17 to act on, and what to remove from the navigation context as follows. Commands operate
18 on the current selection, and, in general, remove the navigation nodes that lie on the branch
19 leading from the current selection to the command. Further, additional heuristics may be
20 used for unusual cases.

21 Current selections in the documents-with-links UI are similar to current selections
22 in prior art desktop UIs, but there are differences because the documents-with-links UI
23 deals with a network of active documents that are different than a desktop of active
24 windows. The two schemes are similar in that every document can have a single, possibly
25 disjoint, selected area. The schemes differ in that the documents-with-links UI can't use
26 the idea of the current focus to decide what selection a command should operate on. In
27 prior art desktop UIs, the document the user wants to operate on typically has the current
28 focus, and all UI elements implicitly reference this focus. In the documents-with-links UI
29 world, the user may have navigated several hops away from the document the user wants

1 to operate on, as the user looked for the desired command, so, in the documents-with-links
2 UI, focus doesn't disambiguate anything.

3 Therefore, in accordance with a preferred embodiment, instead of the current
4 selection being the one whose document has the focus, the current selection is the most
5 recently selected area. All commands that are configured to operate on selections will
6 operate on that most recently selected area. Having executed, they will trim the navigation
7 context at the branch point that leads from the current selection to the command itself.

8 The benefit is that users are free to link into the web of UI pages, exploring them as
9 necessary to find the desired command, and then to invoke it. The act of doing so will end
10 up trimming all the UI navigation from the context, leaving the user back where the user
11 was before navigating to UI pages. Note that depending on the length and content of the
12 navigational path between the command and recent selection, the UI may show the user the
13 target and prompt the user to confirm before proceeding.

14 Note that if no selection exists when a command is executed, then the next
15 selection the user establishes will be considered to be the most recent selection for
16 purposes of determining the command target. In this case, after the user makes the
17 selection, command buttons will be presented in context with the selection by which the
18 user can confirm or cancel execution of the previously selected command. Of course, other
19 suitable methods of determining what selection to operate on are also possible. For
20 instance, one such method is to allow only a single selection to be extant at a time. That is,
21 any time a new selection is initiated, any prior selection is cancelled (un-selected).
22 Another method is to choose what selection to operate on by doing a backwards scan in
23 time order through the navigation context until an active selection is found. In most cases
24 envisioned by the inventors, this latter solution produces the same result as the first one
25 discussed; i.e., the most recent selection will be found.

26 The effect of the algorithm for trimming the navigational context is typically to
27 isolate and remove the branch whose purpose was to find the command that was just
28 executed. Trimming the navigational context of navigation to UI pages does not always
29 occur, however. For example, an Apply command for property setting could leave the
30 property form active and not trim the navigation context. Of course, different commands

1 may choose to operate on the navigation context in different ways. Nevertheless, a couple
2 standard ways will typically cover most of the cases.

3 **Flexible Selection Model**

4 The documents-with-links UI does not require users to make a selection before
5 invoking a command. Users are free to select first and then click a command, or click the
6 command first and then make a selection. If an appropriate selection does not exist when a
7 command is invoked, the user is prompted to make a selection at that time. The selection
8 mechanism and command verbs are designed to give users a lot of latitude about the order
9 in which they do things when carrying out commands. Besides fitting better to users'
10 personal habits, this makes it harder for users to do something "wrong," such as
11 inadvertently applying formatting to text other than the text the user wants to reformat.

12 **Page Display Depends Upon The Link Used To Navigate To The Page**

13 The documents-with-links UI may display the same page of a document differently
14 depending upon which link navigated a user to the page. Suppose the user wants to fill in
15 the TO: field of an e-mail message. In this situation, the user wants to open the address
16 book and make possibly several choices. To accomplish this within the
17 document/navigation metaphor, forms could have special-purpose chooser controls where
18 this provides a good shortcut for the most common choices. But the chooser UI should
19 also make it possible to leverage the full power of the navigation, browsing, viewing, and
20 search UI that is available in list-oriented documents like file folders and the address book.
21 Making a choice from such a list should be a matter of just navigating to that list as a user
22 would in any other context and making the choice.

23 For the address book example, the documents-with-links UI provides a link to the
24 address book that is associated with the input field. The documents-with-links UI makes
25 the link from an input field to its choice document, the address book in this example, be a
26 command with navigation behavior, as opposed to being an ordinary link. This command
27 navigates the user to the document the user needs to choose from and captures anything the
28 user selects. After selecting the addresses the user wants, the user can simply navigate
29 back to the send form where the TO: field is. Alternatively, the user could close the
30 address book or use an OK command, either of which would return the user automatically.

1 There is nothing to save, because all choice state is captured as the user proceeds. If there
2 is a change in plan, the user could simply cancel the current selection, or clear the TO:
3 field when the user returns.

4 If the user later wants to change the TO: field choices, the user may click the TO:
5 field link again, and the user is taken back to the address book, with all the current choices
6 still highlighted. The current choices are highlighted because the command that takes the
7 user to the address book picks up the TO: state and paints the required selection regions.

8 To facilitate making selections in scenarios like this address book example, an
9 additional facility is provided. The command which presents the document to choose from
10 can also cause checkboxes to appear next to each entry in the document. Rather than
11 manually selecting items in the document, the user can check or uncheck the checkboxes.
12 This causes the associated entry to be selected or unselected, respectively.

13 In this address book example, the user is accessing a standard document, the
14 address book, and the normal multiple selection idiom to make and change the user's TO:
15 field fill-in choices. The user has the full power of the normal UI for navigating, viewing,
16 and searching, the address book and can navigate to other documents containing addresses
17 where the user can make other choices. Note that because the selection state is associated
18 with the path the user took to reach the address book, the user will see the TO: items
19 highlighted in the address book only if the user links to the address book (or successor
20 nodes) via the TO: field in question. Thus, the existence of an active To: field does not
21 interfere with other uses of the address book or with other active To: fields.

22 This is a significant principle of the documents-with-links UI: the path a user takes
23 to reach a document typically affects the behavior and presentation of the document. This
24 is a way to achieve state-like behavior without requiring special modes or UI mechanisms
25 like dialogs. The implementation of chooser fields is one of the more important uses of
26 this concept.

27 **Modeless UI**

28 Unlike prior art UI's, the documents-with-links UI is essentially modeless. For
29 example, a user could be involved in filling out a form for carrying out a UI operation such
30 as creating a formatting style for a table. In the middle of doing this the user could

1 navigate away from this UI form and get engaged in some other UI operation, such as
2 filling out another form for a different purpose, and then, at any time, navigate back to the
3 original, incomplete form. There is no restriction on the number of such incomplete
4 operations that can be in progress simultaneously. Nor is there any limitation on switching
5 away from such incomplete operations. This is unlike the prior art, where complex
6 operations, typically performed via dialogs, must generally be complete or cancelled
7 before the user switches to another activity. Unlike prior UI's, the user of a documents-
8 with-links UI is typically not restricted from interrupting one operation to initiate another,
9 or several others, nor would such an interruption cause the user to lose work already
10 performed in partially completing the first operation.

11 **Creating And Saving Information**

12 Another architectural topic central to the documents-with-links UI is the model for
13 creating and saving information. Any time a user creates something new, the user is
14 creating a new document and linking it into a context. For an object inserted into an
15 existing document, such as an embedded annotation, the user is linking it into the
16 document that is to contain it, with link properties implicitly set to make the object
17 visualize in place (OLE-style embedding). Physically, the object is stored as a child within
18 the parent document's container.

19 For new, standalone objects, like a new word processing document, the object is
20 instead added to the current navigation context, as if the user had done a Next to it from
21 wherever the user was when the user issued the New command. Physically, the object may
22 be stored in the user's sea of "free space" in a hidden system folder, not part of any folder
23 the user is aware of, unless and until the user chooses to file it somewhere.

24 The user does not need to put documents into a filing hierarchy or save them. This
25 is because the documents-with-links UI stores all navigational history. Accordingly, users
26 can find the documents they create by viewing or searching their history map. A user
27 could file a document into a folder as an optional step, using a Save As command or by
28 manually creating a link in the folder that leads to the document (the Save As command
29 could be simply a shortcut for creating such a link). Also, the user could use Save / Save
30 As to update or create versions of a document in the filing hierarchy as desired.

1 **Example Hardware Platforms For Implementing Aspects Of The Invention**

2 FIG. 1 is a schematic diagram of a conventional general-purpose digital computing
3 environment that can be used to implement various aspects of the invention. Computer
4 100 includes a processing unit 110, a system memory 120, and a system bus 130 that
5 couples various system components including the system memory to the processing unit
6 110. The system bus 130 may be any of several types of bus structures including a memory
7 bus or memory controller, a peripheral bus, and a local bus using any of a variety of bus
8 architectures. The system memory includes read only memory (ROM) 140 and random
9 access memory (RAM) 150.

10 A basic input/output system 160 (BIOS), containing the basic routines that help to
11 transfer information between elements within the computer 100, such as during start-up, is
12 stored in ROM 140. Computer 100 also includes a hard disk drive 170 for reading from
13 and writing to a hard disk (not shown), a magnetic disk drive 180 for reading from or
14 writing to a removable magnetic disk 190, and an optical disk drive 191 for reading from
15 or writing to a removable optical disk 192 such as a CD ROM or other optical media. The
16 hard disk drive 170, magnetic disk drive 180, and optical disk drive 191 are connected to
17 the system bus 130 by a hard disk drive interface 192, a magnetic disk drive interface 193,
18 and an optical disk drive interface 194, respectively. The drives and their associated
19 computer-readable media provide nonvolatile storage of computer readable instructions,
20 data structures, program modules and other data for the personal computer 100. It will be
21 appreciated by those skilled in the art that other types of computer readable media which
22 can store data that is accessible by a computer, such as magnetic cassettes, flash memory
23 cards, digital video disks, Bernoulli cartridges, random access memories (RAMs), read
24 only memories (ROMs), and the like, may also be used in the example operating
25 environment.

26 A number of program modules can be stored on the hard disk, magnetic disk 190,
27 optical disk 192, ROM 140 or RAM 150, including an operating system 195, one or more
28 application programs 196, other program modules 197, and program data 198. A user can
29 enter commands and information into the computer 100 through input devices such as a
30 keyboard 101 and pointing device 102. Other input devices (not shown) may include a

1 microphone, joystick, game pad, satellite dish, scanner, or the like. These and other input
2 devices are often connected to the processing unit 110 through a serial port interface 106
3 that is coupled to the system bus, but may be connected by other interfaces, such as a
4 parallel port, game port or a universal serial bus (USB). A monitor 107 or other type of
5 display device is also connected to the system bus 130 via an interface, such as a video
6 adapter 108. In addition to the monitor, personal computers typically include other
7 peripheral output devices (not shown), such as speakers and printers.

8 The computer 100 can operate in a networked environment using logical
9 connections to one or more remote computers, such as a remote computer 109. Remote
10 computer 109 can be a server, a router, a network PC, a peer device or other common
11 network node, and typically includes many or all of the elements described above relative
12 to computer 100, although only a memory storage device 111 has been illustrated in FIG.
13 1. The logical connections depicted in FIG. 1 include a local area network (LAN) 112 and
14 a wide area network (WAN) 113. Such networking environments are commonplace in
15 offices, enterprise-wide computer networks, intranets and the Internet.

16 When used in a LAN networking environment, the computer 100 is connected to the local
17 network 112 through a network interface or adapter 114. When used in a WAN networking
18 environment, the personal computer 100 typically includes a modem 115 or other means
19 for establishing a communications over the wide area network 113, such as the Internet.
20 The modem 115, which may be internal or external, is connected to the system bus 130 via
21 the serial port interface 106. In a networked environment, program modules depicted
22 relative to the personal computer 100, or portions thereof, may be stored in the remote
23 memory storage device.

24 It will be appreciated that the network connections shown are example and other
25 means of establishing a communications link between the computers can be used. The
26 existence of any of various well-known protocols such as TCP/IP, Ethernet, FTP, HTTP
27 and the like is presumed, and the system can be operated in a client-server configuration to
28 permit a user to retrieve web pages from a web-based server. Any of various conventional
29 web browsers can be used to display and manipulate data on web pages.

1 FIG. 2 shows a tablet and stylus computer that can be used in accordance with
2 various aspects of the present invention. Any or all of the features, subsystems, and
3 functions in the system of FIG. 1 can be included in the computer of FIG. 2. Computer
4 201 includes a large display surface 202 (e.g., a flat panel display) on which a plurality of
5 windows 203 is displayed. Using stylus 204, a user can select, highlight, and write on the
6 display area. Computer 201 interprets marks made using stylus 204 in order to manipulate
7 data, enter text, and execute conventional computer application tasks such as spreadsheets,
8 word processing programs, and the like. One commercially available tablet and stylus
9 computer incorporating many of these features is the Stylistic 2300 computer sold by
10 Fujitsu Personal Systems, Inc., of Santa Clara, California.

11 A stylus could be equipped with buttons or other features to augment its selection
12 capabilities. In one embodiment, a stylus could be implemented as a “pencil” or “pen” in
13 which one end constitutes a writing portion and the other end constitutes an “eraser” end
14 which, when moved across the display, indicates that portions of the display are to be
15 erased. Other types of input devices such as a mouse, trackball, or the like could be used.
16 Additionally, a user’s own finger could be used to select or indicate portions of the
17 displayed image on a touch-sensitive or proximity-sensitive display. Consequently, the
18 term “user input device” is intended to have a broad definition and encompasses many
19 variations on well-known input devices.

20 **Example Steps For Implementing Aspects Of The Invention**

21 FIG. 3 is a flowchart showing simplified steps at a high level of abstraction for
22 implementing a UI architecture according to the principles of this invention upon start up.
23 Processing begins at start block 300. In step 302, the system checks to see whether there is
24 a prior existing state. If there is a prior existing state, then that state is used as the current
25 state. If there is no prior existing state, then in step 304 the system retrieves a previously
26 stored default prior state and assigns the value of that default state, which could be, for
27 instance, a default start page, to the current state. In a preferred embodiment, like other
28 content and UI, the current state is stored as a document that contains links.

29 In step 308, the system waits for input from a user. Upon user input, the system
30 determines the nature of the user input in step 310. Gestures for performing UI actions are

1 discussed below. The nature of the user input could include a combination of the input
2 device, such as a pen, and the gesture performed by the user. The system then determines
3 the region of the user input in step 312, and, based upon the region of the user input,
4 determines an object associated with the region in step 314. The system then determines
5 an action to be performed based upon both the nature of the user input and the object
6 associated with the region of the input in step 316. The system then performs the action in
7 step 318. The system then loops back to step 308 to wait for more user input.

8 FIG. 4 is a flow chart showing simplified steps for implementing the “display state”
9 step, step 306, in FIG. 3. Referring to FIG. 4, processing begins at block 400. In step 402,
10 the system retrieves a link from the previously saved display state, which may include a
11 list of active or visible links. The retrieved link’s display properties are examined in step
12 404. In step 406, a frame is then displayed based on the link’s properties. In step 408, a
13 check is performed to see whether, based upon the link’s properties, linked-to content or
14 other information about the linked-to document is to be displayed in the link’s display
15 frame. If such content or information is to be displayed, then the link’s target is examined,
16 as depicted in step 410. Otherwise, there is typically no need to examine the link’s target.
17 Then, in step 412, the link (with or without content or information or both from the linked-
18 to document) is displayed in the display frame. Steps 402-412 are repeated until the check
19 for more links in the current display state fails in step 414. Display state processing then
20 ends in step 416.

21 **Preferred Embodiments of the UI Architecture for a Personal Viewer**

22 Various preferred embodiments of the documents-with-links UI of this invention
23 are described herein as implemented on a personal viewer (hereinafter the term “PV” refers
24 to a personal viewer upon which various aspects of preferred embodiments of a
25 documents-with-links UI according to the principles of this invention are implemented).

26 **Personal Viewer UI Elements**

27 Referring now to FIG. 5, an example Start Page is displayed on a PV UI 500 that
28 includes the following elements:

29 • The display surface 502. This is touch sensitive for both fingertip and pen
30 operations. The touch zones at the four corners 504, 506, 508, and 510 are used

1 to initiate navigation operations such as turning pages and traversing the user's
2 navigational history chain. Labels may be applied to these areas to cue
3 completely naïve users how to turn pages the first time they interact with a PV
4 UI.

5 The display margins. Documents that present on a PV UI typically show as print-
6 like pages, including margins. The margin space is available for jotting notes
7 and displaying UI-generated features like bookmark tabs and UI shortcuts. A
8 default margin arrangement could be

- 9 – Top margin 512: bookmark tabs. Bookmarks or other objects placed here
10 are associated with the containing document.
- 11 – Bottom margin 514: document and command shortcuts and toolbar tabs.
12 Document shortcuts or other objects placed here are associated with the
13 display surface.
- 14 – Left margin of leftmost display 516: clippings tabs. Clippings or other
15 objects placed here are associated with the containing page.
- 16 – Right margin of rightmost display 518: clipping tabs. Clippings or other
17 objects placed here are associated with the containing page.
- 18 – Inner margin to right of spine 600 (see FIG. 6) (dual display PV UI): no
19 default use.
- 20 – Inner margin to left of spine 602: no default use.

21 In the above list, examples of other objects that may be present in any of the
22 margins are user annotations.

23 A user can reassign which functions are associated with which margin.
24 Accordingly, the margins may be referred to as the bookmark, document, clip,
25 and command margins, respectively. Of course, other suitable default margin
26 arrangements could also be used. For instance, there could be a zone around
27 the entire document that is outside the document called the edge zone or zones.
28 The edge zones could contain command shortcuts and other kinds of links.
29 Command and shortcuts and toolbar tabs could prefer the lower edge zone, and

1 links representing the thumbnail view of documents could prefer the left and
2 upper edge zones. Because a page margin would not be needed for carrying
3 command links, clipping tabs could by default use the left margin of the left
4 page for clippings on the left page and the right margin of the right page for
5 clippings on the right page. The inner margins could remain unused, except if
6 the user puts annotations or other links there.

7 The difference between the margins-only embodiment and the edge-zones
8 embodiment is that, in the margins-only embodiment, the user sees no
9 surrounding frame, and a tap action in the margins has the defaults specified in
10 the list above. In the edge zones embodiment, the user sees a surrounding
11 frame that is wide enough to provide an edge zone, and taps in the
12 corresponding edge zones have the effects specified in the list above. In this
13 latter embodiment, the default action for taps in each of the document's margins
14 is to insert an embedded annotation (i.e., a user note). In the margins-only
15 embodiment, the user would insert annotations into a margin not by tapping
16 there but by explicitly invoking a command, such as an Insert Note command
17 available on the margin's popup menu.

- 18 • The display content. This is the area inside the page margins where content is
19 displayed. Content may include links that the user can navigate by touching
20 them, as well as user-created highlighting, jottings, and embedded notes and
21 recordings.
- 22 • The note form. This is a document template that is used to implement several
23 important PV UI features, including bookmarks, notes, and clippings. The note
24 form is just a blank document that has predefined fields like an entry field for a
25 title, and option boxes to control the note's presentation and behavior (e.g., its
26 color, type, source back link, and anchor spec). The note form can also have a
27 Send button.
- 28 • The built-in documents. The PV has a few built-in documents, as listed below.
29 There is nothing "special" about being a built-in document; these are just

1 documents that a PV UI happens to contain by default. The list can be
2 customized as desired. Possible standard built-ins are:

- 3 – Sign-in Page. This document provides the form for signing in if and when a
4 PV is set in a secure mode.
- 5 – Start Page. An example Start Page is depicted in FIG. 5. This is the central
6 starting point for the PV UI. From here a user can link to any content,
7 including UI, accessible to the user, for instance, documents on the PV itself
8 as well as in the user's desktop workspace and the Internet. The Start Page
9 may take the form of a personal newsletter.
- 10 – My Documents 520. This is a folder listing of all the documents a user has
11 read, authored, subscribed to, or purchased. It is essentially a catalog of a
12 user's personal library. It supports various views to let a user get an
13 overview of what content the user has and to find the content that the user is
14 looking for. My Documents may have links to other PV content like the
15 Address Book and Guide Book, for instance.
- 16 – Guide Book. This is both the PV's help document and the PV's user
17 interface. Example pages of an Guide Book are shown in FIG. 7. The UI is
18 embedded in the Guide Book as links that perform UI functions according
19 to the principles of this invention. The Guide Book includes the Quick
20 Help page of frequently used UI commands. FIG. 8 depicts an example
21 Quick Help page.
- 22 – Map book. A book of maps, including the current site map, history map,
23 topic (browsing) map, net neighborhood, physical vicinity (nearby
24 machines), and local machine.
- 25 – Annotations Folder. This is a folder of the notes, clippings, bookmarks,
26 jottings, and highlights a user has entered into the user's various documents.
27 A user will typically be able to see each of these forms of annotations in the
28 context of the original document to which they relate. These items are
29 stored as external annotations in the Annotations Folder. A user does not

1 usually view this folder, but instead views one of the following persistent
2 views derived from the Annotations Folder.

- 3 · Clippings Folder. A persistent view of the Annotations Folder, showing
4 only clippings. The default view categorizes by document, with more
5 recently read documents ahead of less recently read documents.
- 6 · Bookmarks Folder. Same as the Clippings Folder, but showing only
7 bookmarks.
- 8 · The Notes Folder. Same as the Clippings Folder, but showing only
9 notes.
- 10 – Notebook. This is a blank document where a user can write notes that are
11 not associated with a particular document. The notebook is provided by
12 default because most users would like to have a notebook to write in.
- 13 – The mailbox, calendar, and address book. In a preferred embodiment, these
14 will synchronize with a user's desktop or network-based counterparts.

15 **Personal Viewer Display Modes**

16 A PV UI can include a single-display and/or a dual-display. Some dual-display UI
17 actions will cause only the rightmost display image to be replaced. When this happens, the
18 original image may or may not be shifted to the left display when this happens. A rule that
19 can be used is that when the UI action was invoked from a link or menu action initiated on
20 the right display, the image is shifted to the left display and the new page opens on the
21 right. If the action was initiated on the left display, the new page simply opens on the right
22 and no shift occurs. The result is that the new page opens on the right and the page from
23 which it was initiated appears on the left.

24 For a single-display PV, the current display image is simply replaced by the new
25 page. A user can use the Previous and Next functions to flip between the original and new
26 pages.

27 A PV can be held horizontally or vertically. Further, dual-display PV's can treat
28 the two displays as separate pages, or as halves of the same (large) page. The PV can adapt
29 its assignment of case touch zones and display areas to present a consistent geometry to the

1 user regardless of its orientation and display mode. That is, the PV re-maps its definition
2 of things like “upper left corner” and “right margin” to be consistent with its current
3 orientation.

4 **Gestures For Performing PV UI Actions**

5 While other suitable input equipment could also be used, PV UI actions will be
6 described as occurring via touch operations using a fingertip or pen. Users can use a
7 fingertip or the pen, also referred to as a stylus, interchangeably. The pen could have three
8 tips: an erasing tip at one end, a highlighting tip at the other, and, by twisting the pen barrel
9 to extend a small shaft, a writing tip. The fingertip may be recognized as a highlighting
10 tip, with a gesture allowing it to erase.

11 The basic touch idioms are:

- 12 • Tap (touch and release after a brief time). The action taken depends on where a
13 user tapped. It does not depend on what tip the user is using. The tap would
14 typically last a certain minimum (configurable) time, so that an accidental or
15 glancing touch will be ignored.
- 16 • Hold (touch and hold contact). The action taken depends on what the user held;
17 usually it opens an object or its context menu. The action does not depend on
18 what tip is being used. The hold time can be a preference parameter.
- 19 • Swipe. A swipe is any continuous motion of a tip in contact with the display
20 surface. Swiping will write or erase ink or highlighting, depending on which
21 tip is being used. Swipes are also used to make and extend current selections.
- 22 • Tap-swipe. A tap immediately followed by a swipe starting at the same spot.
23 This causes the pen or fingertip to start a current selection region. Either the
24 writing or highlighting tip can be used. Swiping starting at the current edit
25 cursor location (i.e., the tap is optional when starting on top of the edit cursor)
26 can also draw a selection.
- 27 • Erase (a jiggling swipe). When done with the fingertip, this is treated as a
28 swipe with the erasing tip. (The motion is the same as erasing with a real pencil
29 eraser). With the pen, a user can just swipe with the erasing tip.

1 A user can automatically extend the range of a highlight, current selection, or
2 erasure by holding the pen or fingertip after swiping a part of the range; that is, swipe part
3 of the range, then hold for auto-complete to take over. The range auto-extends to end of
4 word, sentence or line, paragraph, page, section or chapter, and document, in that order, the
5 longer a user holds. The UI provides feedback on the extent of the selection. In tables, the
6 selection auto-extends by cells to the end of a row or column, and then by rows or
7 columns, depending on whether the swipe was across or down. Arbitrary rectangular
8 blocks can be highlighted, selected, or erased by swiping a box shape around the desired
9 area. Selecting the page number of a page selects the whole page.

10 Typically, whatever a user can do with a pen, the user can do with a fingertip,
11 except write ink. While other mapping are of course possible, an example set of
12 keyboard/mouse idioms for the pen idioms and pen tips is:

- 13 • Tap is left-click
- 14 • Hold is hold left button
- 15 • Swipe is hold left or right button and move mouse. Swiping with left button down
16 selects, with right down highlights. There is no need for tap-swipe.
- 17 • Erase is hold both buttons and move mouse
- 18 • Jotting is done via the keyboard (i.e., the user gets text instead of ink)
- 19 • The mouse supports a few other idioms as follows. These and other idioms can be
20 customized.
- 21 • Right click brings up a context menu, the same one that a hold operation at this
22 location would.
- 23 • Mouse wheel does page forward and back operations.
- 24 • Clicking the mouse wheel / third button links to the Quick Help page.

25 **Navigating**

26 **Hyperlinking**

27 One way to navigate is by hyperlinking. The PV UI renders textual hyperlinks
28 using a visual emphasis similar to the way a prior art browser does. Tapping a link will
29 navigate the user to the linked-to place. The user can use the Previous and Next operations

1 to move along the link chain. The PV UI Start Page can exist as the most previous
2 document page in the chain.

3 A user can also hold a link. Doing this will perform a link-specific action. The
4 default behavior for hyperlinks is to present preview information about where the link will
5 take the user; i.e., document name and document position information and/or a thumbnail
6 view of the linked-to document. Continuing to hold the link could cause the preview
7 information to expand into a navigational map of the link context emanating from the link
8 the user is holding. Popup menu choices could also be presented allowing the user to
9 manipulate the link, such as to change its properties.

10 When the user releases a held link no navigation occurs. The user can tap the link
11 to make it navigate. If holding the link opened a navigation map, the map will persist for a
12 short time after the user lets go. This gives the user a chance to tap a spot on the map to go
13 there, or to hold a spot in order to preview and then to expand the map context around that
14 point.

15 **Next And Previous Commands**

16 Another way to navigate is via browser-like Next and Previous commands,
17 performed (in the default assignment) by tapping the PV's lower right and left corners 508
18 and 510, respectively. Specifically, these functions navigate a user along the chain of
19 visitations caused by link operations.

20 Page-turning operations are not part of the next/previous chain. For example, if a
21 user opens a book, reads the first ten pages and then does "previous", the user will return to
22 wherever the user was before the book was opened. The user will not go back to the
23 previous page of the current document (for that, the user can use the previous page
24 operation 504). The distinct page-level and navigation-level functions exist because the
25 page forward/back functions 504 and 506 take the place of the traditional scrollbar for
26 scanning within a single document.

27 **Scrolling Is Possible**

28 Even though the PV UI is page oriented, there are times when a scroll-oriented
29 presentation is the only reasonable display choice. The PV UI supports this by displaying
30 traditional scroll bars when stream-oriented presentation is required. The user may touch

1 the scroll bars to perform the scrolling actions. This looks and works much like
2 conventional scroll bars.

3 **Users Can Create Links**

4 PV UI users are not limited to the links that are authored into content; they can
5 create their own. The PV UI implements a rich linking model in which links can have
6 source and destination anchor ranges as well as their own properties. Despite the richness
7 of available features, users can create links as easily as they can copy text, and all with a
8 fingertip; the pen is not required.

9 **Links**

10 **Displaying Links**

11 How a link is displayed is controlled by its properties. Conventions and heuristics
12 may be used to assign values to these properties at the time the link is created. A simple
13 example is that when the user taps inside the content of a document, a note is created. This
14 entails creating a note document and then creating a link leading from the spot that was
15 tapped to the new note document. In this case the link properties are set to visualize the
16 link as a note icon. As another example if the user highlights some text in a user document
17 and then chooses the “Make link command”, followed by the steps to complete that
18 command, the link is made to visualize as a hotspot over the originally selected text, with
19 the selected text changed (for example) to a blue underlined font. Unless a user changes a
20 link’s display properties, once these property-setting decisions are made, the link will
21 typically continue to be displayed in the same way.

22 Depending upon a link’s properties, when the link is displayed, content of the linked-to
23 document, or other information about the linked-to document, may be displayed in a frame
24 in the linked-from document. For instance, two example previous links, previous link 700
25 in FIG. 7 and previous link 1102 in FIG. 11, depict how examining a link’s target allows
26 the PV UI to display information about the destination of a link. For instance, the
27 destination of link 700 is Earth to the Moon, while the destination of link 1102 is the Start
28 Page.

Link Property Sheet

A PV UI link property sheet, like user content and other UI pages, is implemented as a document. It has several pages. The first page is the subset of properties that users would most commonly change, presented in a way that less expert users can understand. Subsequent pages provide the full set of advanced properties and options. Typically, only the most expert user (a content author) would ever modify these.

For example, the first page may contain just the property comments (a notes field), information about where the link leads to, and a chooser that lets a user choose from a few options on how the hotspot should appear (e.g., emphasized text, button, icon, or thumbnail).

The subsequent pages give full access to properties including the source and destination anchor specifications, the visual extent and appearance of the hotspot, and the link behavior options. Each page of the link property sheet is bookmarked so a user can jump directly to it if desired.

Together, the set of link property pages encompasses a lot of information, including general properties, source and destination anchors, hotspot characteristics, and link behavior:

- General properties. These include the type and file system properties of the link. Link type information describes the semantic nature of the link and how it relates the things being linked. Typically, only authoring and viewing software would ever access the type properties, as they pertain to the organization of the material containing the links. Type indicates whether the link expresses a parent, child, or peer relationship, and whether the destination represents:
 - A document component: a figure, table, footnote, or other cross-reference.
 - The next or previous “page” (in the web sense) of the current document/topic.
 - The next or previous document/topic in an authored web of documents/topics.
 - Something not part of the current document/topic: a comment or hyperlink.

1 • Source anchor. Specifies whether the link is anchored to a character, word,
2 paragraph, image, part of an image, table row, cell, or column, or an arbitrary
3 range of document positions. This parameter is automatically set according to
4 the source selection the user makes when creating the link; this property
5 provides a way to change the anchor.

6 • Hotspot. Specifies the physical extent and appearance of the hotspot. By
7 default the extent matches that of the anchor, but it can be made bigger or
8 smaller and of arbitrary shape; noncontiguous hotspots are also possible. For
9 hotspots on text, the default appearance is blue underlined text, but the
10 foreground and background colors and text attributes can be changed. Other
11 appearance options include manifesting the link as an icon, button, thumbnail of
12 the link target, or as an in-place (active) rendering of the link target. Hotspots
13 can also be invisible, which is appropriate for links over GIF images, for
14 instance. Another hotspot option specifies how the link is previewed: any or all
15 of: the name of the target, a thumbnail of it, and/or specific balloon text.

16 • Destination anchor. Specifies the target of the link and its range. The basic link
17 creation UI results in destination anchors that are a single document position (a
18 “point”) rather than a range. Destination ranges that are not points are a very
19 advanced feature mainly used in implementing certain viewing and
20 collaboration features. For example, if the destination anchor is a range, the
21 viewing software can automatically synthesize appropriate link preview
22 information based on the content of the range.

23 • Behavior. Specifies the action to take on tap and hold operations. Choices
24 include

25 – Navigate. Goes to the link destination.

26 – Preview. Pops up navigational preview information as explained above.

27 – Run. Causes the destination content to be executed, with specified run
28 parameters. The target is typically a command or script.

1 Additionally, for links set to appear as thumbnails or in-place renderings, other
2 behavior properties could indicate latency periods for updating the display of
3 the linked-to content relative to a change in the linked-to content by, for
4 instance, specifying a link as hot (display updated often), warm (display
5 updated less often than hot), or cold (display not updated). Further behavior
6 properties could set the pre-fetch, refresh, and caching parameters for hot and
7 warm links.

8

9 **Customizable UI**

10 The user may completely customize the PV UI (unless authored-in content controls
11 prevent editing). Because there is no distinction between the interface and the content, the
12 kinds of normal editing commands the user might use to alter content can be used to
13 customize the interface.

14 **Users Can Place Links In UI**

15 For instance, links are not restricted to existing only in the content area of the
16 display. They can exist anywhere. A user could, for example, place a link over a
17 bookmark; the link would take precedence for tap operations, meaning that the bookmark
18 would act as a document-associated shortcut to some other document; whereas a bookmark
19 is normally a link within the current document.

20 **Page Pinning**

21 The PV UI display may be divided into regions in which different content may be
22 displayed. Unlike prior art UIs, each region may be individually navigated without
23 changing focus or “window” state. Each region may include concurrently active links that
24 may be activated without changing focus. This aspect of the current invention is referred
25 to as page pinning. Page pinning provides access to and interaction with multiple sources
26 of content concurrently, while reducing the complexity associated with both the design and
27 use of the interface.

28 In prior art user interfaces, each window runs a separate application that has state
29 information associated with it. For instance the state information for a word processor
30 might be that it is currently in insert mode, or replace mode and what the current font is.

1 The user often has to keep in mind which application is running in which window and
2 what the state of that application is to avoid unexpected results.

3 In the PV UI, unlike prior art user interfaces, there is no notion of a selected one of
4 multiple windows having the current "focus." Any display region may include active
5 links. The user can touch anywhere on the screen and will get an appropriate action based
6 on what the user touches. For instance, if a user has a page pinned as depicted in FIG. 9,
7 and both pages being displayed contain links the user can simply touch a link in either
8 page and the link will be activated.

9 Superficially, page pinning resembles a multi-windowing user interface. The same
10 may be said for dialog boxes that may be included in a documents-with-links UI according
11 to the principles of this invention. Nevertheless, unlike this invention, multi-windowing
12 UIs contain more than one UI. Each window in a multi-windowing UI gets its own UI,
13 with its own state information, such as history information, and its own UI features, such
14 as menu or tool bars. According to the principles of this invention, pinned pages, like all
15 other content (the UI included), share a single UI having only one set of state information
16 and having a unified navigational history. There are no separate UI controls, such as menu
17 bars or tool bars, for the separate concurrently displayed pages. The unified navigational
18 history is discussed in more detail below.

19 When the user has pinned a page and is viewing two pages side-by-side, the user
20 essentially has two different view ports into a single navigation context. A set of
21 documents exists in a navigation context. The navigation context is essentially a record of
22 every place a user has ever navigated to and when the user navigated there. The navigation
23 context can be thought of as a map or history of the user's navigation. A visible frame,
24 such as a pinned page is just a view port into a single shared history. The only state
25 associated with a displayed page-pinning frame is an indication of the document page that
26 is currently being displayed. 

27 ~~Page pinning is described further in commonly assigned U.S. Patent Application~~
28 Serial No. _____, entitled Methods And Apparatus For Displaying Multiple
29 Contexts In Electronic Documents, filed contemporaneously herewith, which is
30 incorporated herein by reference.

1 **Navigating Documents/Link Properties**

2 The PV UI contains methods for paging within a document (previous/next) and for
3 traversing chronology (history through back/forward). Attaching properties to links
4 enables a rich model for navigation. For example, holding on a link offers additional
5 information about where that link will lead. Link preview information could be displayed
6 in thumbnail form and further holding could result in a graphical map of the links attached
7 to that prospective destination. Back and forward buttons, by default, display thumbnail
8 views of the pages that tapping that button will lead to.

9 **Viewing History**

10 History (which could include all the pages the user has viewed) may be viewed in a
11 number of ways: by time, by appearance, by site, document, section, page, and the like.
12 Since a user's navigation history is saved, the users' sequence may be viewed: as nodes
13 with side tracking branches, as a linear list, or as a combination of most recently viewed
14 pages and last few task categories. For example, a query could perform a multilevel
15 categorization by document id resulting in a hierarchy that represents all the forward
16 navigation paths a user has taken from any given document. By restricting (filtering) this
17 categorization to a particular time frame, the navigation network as it existed at a particular
18 point in time can be shown. Of course, other kinds of views are also possible. For
19 example, the history can be categorized by higher level groupings like web sites or user
20 tasks, with the results presented in alphabetical rather than time order, thus letting users
21 return to a previous location according to the kind of information or activity, as opposed to
22 the time during which, the location was last visited. To make certain views such as the
23 network view more efficient to recreate, additional property information may be stored on
24 each navigation record. Accordingly, maintaining the navigation context as a database of
25 navigation records allows support for a rich variety of queries and views.

26 **Applies To UI**

27 Because the UI is built out of content, features used to search text, change viewing
28 options on lists and tables, annotate, and the like all work for UI as well as for user content.
29 As an example, the contents of any view, such as a view of a filing or command hierarchy,
30 become searchable, sortable, and annotatable.

1 Non-Linear Navigation History

2 A key difference between the navigation mechanism of the PV UI and prior art
3 browsers is that the PV UI, unlike prior art browsers, maintains a non-linear navigation
4 history. For example, if a user navigates through a set of links then goes “back” several
5 steps, and then navigates through a different set of links, the user is still able to go “back”
6 and then retrace the original path of links they navigated. With prior art browser’s this is
7 not possible—recollection of the first set of documents that were “backed” over is lost.

8 Further, the PV UI maintains a nonlinear navigation context that records every
9 place a user has ever navigated to, when in time the user was there, and where the user
10 went to from there. This, in turn, allows a user to navigate from general content pages into
11 user interface pages, perform interface functionality, and then return to the user’s
12 documents without losing what the user’s navigational context was before navigating to
13 the user interface pages. As described in more detail above in the Rich Navigation And
14 Maintaining The User’s Navigational History section, this invention automatically
15 removes navigation from the beginning of navigation into UI pages that lead up to
16 performance of some UI functionality so the user’s navigational history does not get
17 cluttered with navigation within UI pages. Saving the user’s navigation history may also
18 help a user retrace navigational steps that the user would not otherwise be able to
19 remember. For instance, suppose a user does not remember where they were when they
20 viewed some content they liked. If the user remembers where they had been before they
21 viewed that content, then the user can navigate to this prior place and query navigational
22 history for everywhere they had navigated to from that particular location.

23 This is very unlike prior art multi-windowing UIs in which each application has its
24 own navigation history that can not be integrated with the history of other applications a
25 user is concurrently running. For example, suppose a user runs a word processor and a
26 browser concurrently on a desktop computer. The user can switch between them in a way
27 well known in the art. The word processor and the web browser will both have their own
28 state information. In other words, the word processor and the web browser will each be
29 separately nested in their own experience of history or navigation. As a result, if the user
30 switches from the word processor to the browser, visits a few web sites and wants to return

1 to the word processor, the user will not be able to get back to the word processor by hitting
2 the browser's "back" button. The browser and the word processor essentially exist in
3 separate contexts, with each context having its own state information and unique history.

4 **Annotations**

5 **Making Annotations**

6 *SJ* The PV UI allows a user to interact with content and the UI to make either or both
7 more memorable, via bookmarks, clippings, highlights, overlaid and embedded ink and
8 audio notes. Bookmarks are described further in commonly assigned U.S. Patent
9 Application Serial No. _____, entitled Bookmarking and Placemarking a
10 Displayed Document in a Computer System, filed contemporaneously herewith, which is
11 incorporated herein by reference. Example bookmarks 800 and 802 are depicted in FIG. 8.
12 Ink annotations are described further in commonly assigned U.S. Patent Application Serial
13 No. _____, entitled System And Method For Annotating An Electronic Document
14 Independently Of Its Content, filed contemporaneously herewith, which is incorporated
15 herein by reference. Audio annotations are described further in commonly assigned U.S.
16 Patent Application Serial No. _____, entitled Annotating Electronic Information
17 with Audio Clips in an Electronic Device, filed contemporaneously herewith, which is
18 incorporated herein by reference. These annotations may be performed with not only
19 different input methods, but adapted to the most convenient or natural one, such as a finger
20 for highlighting, a stylus for writing or doodling, and speech for lengthier commentary.

21 **Storing Annotations**

22 The annotations exist apart from the content (as files with links to the content);
23 therefore annotations can be displayed not only layered on the content in appropriate
24 positions within the content, such as, for instance, note 1000 in FIG. 10, but in other
25 locations and visualizations. That is, each of these annotations is available to the user not
26 only *in situ*, in the content where it was created, but cross-referenced in automatically-
27 created indices which can be manipulated much as described in the Viewing History
28 section above: by time, by appearance, by site, document, section, page, etc. Likewise,
29 annotations could be shared, selectively shared, or kept private with the kind of
30 functionality described in the Collaboration section below.

1 Interface Shortcuts and Smarts

2 Most-Likely-To-Use-Links and Other Heuristics

3 Sub
4 The PV UI can include heuristics, which allow it to offer up most-likely-to-use
5 links to additional material. One case of these is the context menu that appears when the
6 user holds the Next button; in addition to the most recent documents the user has visited
7 subsequent to the current one, the Next menu includes heuristically determined choices of
8 other places the user may wish to visit (for example, documents on a topic related to the
9 current one). Another case is a feature called an End Page, such as, for instance, End Page
10 1100 depicted in FIG. 11. Such an End Page is essentially a summary page at the end of a
11 document or book that offers the user related topics such as “additional works by this
12 author/on this topic/written in the same time period/commented on by these critics” etc. In
13 the case of directories such as email, where each message is technically a document, the
14 end page offers threads based on that message/other messages by same author/other text on
15 the same topic, and the like.

16 Of course, other heuristics could also be used depending on the context. For
17 example, when offering up a set of command choices to a user, the heuristics could be
18 based on analysis of the user’s current document context, recently used commands, and
19 commands the user has used most frequently in this and similar contexts in the past. Such
20 heuristics are described further, in the context of navigating to a particular portion of the
21 Guide Book, in commonly assigned U.S. Patent Application Serial No. _____,
22 entitled Method and Apparatus for Providing Help and Settings Control to Users of an
23 Electronic Book, filed contemporaneously herewith, which is incorporated herein by
24 reference.

25

Frequently Used Links

26 The PV UI could also provide commands (actually links) embedded in the page
27 that are related to the kind of material on the page. In a mail message for example, “reply”
28 “reply all,” and “forward” are links so frequently used as to warrant their inclusion directly
29 on the page. There may be other commands or links used so often that they are
30 dynamically bubbled up, or in the case of linear reading, used so infrequently that none

1 appear. The second level of visibility—"hold on the page for more information" —offers a
2 more extensive list. If none of these satisfy the user's need, the user can summon the
3 Guide Book.

4 **Start Page**

5 The top level of the PV UI provides the user with a Personal Newsletter or Start
6 Page, which is the launch point for many activities. An example Start Page is depicted in
7 FIG. 5. Highlights might include urgent mail messages, projects, PIM items, documents,
8 news, which could be divided into system-offered default components, such as Messages,
9 Notes, Clippings, and the like. Favorite links that the user wants to keep readily available
10 could also be included. What appears on the Start Page can be both user-configured as
11 well as configured from profile information the PV UI has learned by observing a user's
12 browsing and e-mail reading patterns and the like.

13 **User Can Modify Start Page**

14 Advanced users can perform the same kinds of operations on the interface itself as
15 those performed on content. If the default components on their Start Page are not to their
16 liking, they can delete or alter even system-offered components such as Mail Messages.
17 Or, for instance, if the automatic page number used by the bookmark header is insufficient
18 for recognition, they can alter its text, color or any other property.

19 **Audio Recording and Annotation**

20 ~~Subj~~ The PV UI supports the creation of audio clips that can be used for annotation of
21 any displayed document. The clips are based on a timeline model in which audio (or
22 video) recording is a data stream parallel to and synchronized with the material in a
23 document. If the user has changed pages while recording, then the clip when played back
24 will also change the page when the appropriate place in the audio clip is reached. The
25 interface supports both document and page-specific audio notes as well as global
26 recording. The interface is presented with cassette-like controls, including index
27 forward/back and editing. Each clip is stored as an individual document and can be sorted
28 and filtered to present the clips in multiple ways (all audio on a given page, all audio for a
29 given book, audio notes in the order they were recorded, and the like). Additionally, the
30 audio clip recorder supports intelligent VOX for hands-off note taking. A further feature is

1 the ability to embed audio notes at specific points in the content of a document in a manner
2 similar to creating footnotes. These audio notes can be created and played back by a single
3 tap on the screen at the point where the audio note was (or is to be) inserted. The presence
4 of embedded audio notes is signified by a small icon in the content that is laid out in a
5 manner similar to a footnote symbol. As previously mentioned in the Making Annotations
6 section, audio annotations are described further in commonly assigned U.S. Patent
7 Application Serial No. _____, entitled Annotating Electronic Information with
8 Audio Clips in an Electronic Device, filed contemporaneously herewith, which is
9 incorporated herein by reference.

10

11 **Guide Book**

12 Because the commands in the PV UI are simply links on a document page, there is
13 no difference between documentation, help, wizards and the other ways the PV UI helps a
14 user perform an action. Asking for help by clicking on a help link summons an appropriate
15 help page composed on the fly from the content of the Guide Book. The principles that
16 underlie this composition are contextual: that is, if the user is currently in the “list” or
17 “books” of Mail Messages, the help system infers that requests for assistance are about
18 how to perform work with Mail Messages.

19 For instance, FIG. 8 shows two pages of an example Guide Book. The page on the
20 right, page 9 of 10 includes descriptions of commands, such as the “PIN THIS PAGE”
21 command 800. The Guide Book describes what the command does. For instance, for
22 “PIN THIS PAGE” the description states that “Tapping on this command will “freeze” a
23 secondary copy of the current page and display it as a floating page over the book.” FIG. 9
24 shows an example of a pinned page. In addition to describing this command, the text “PIN
25 THIS PAGE” is a link that, when activated, will execute the “PIN THIS PAGE” command
26 on either the most recently selected page or on a page to be selected after activating the
27 “PIN THIS PAGE” command link.

28 **Obtain Help And Perform Functions In The Same Way**

29 Unlike prior art UIs, the PV UI is constructed as a set of document pages just like a
30 user document or a web site is constructed as set of document pages. This invention puts

1 all of the user's content pages and user interface pages into a single grouping of
2 information that the user can access. This invention then leverages well-known browser-
3 like navigational capabilities to allow a user to navigate back and forth between various
4 pages and to put links to pages in favored lists and the like. All of this is leveraged to
5 provide the means by which a user navigates to user interface pages.

6 The PV UI can provide context-specific dynamically synthesized views of links to
7 give the user direct access to relevant UI help pages. The user can search for user interface
8 functionality in the same way the user can search other document pages. Of course, pop-
9 up menus and other devices such as permanent links placed on the screen that give the user
10 direct access to UI help information can also be provided.

11 Because the Guide Book is simply content, operations that may be performed on
12 other types of content, such as the Start Page, the UI, and content in general may also be
13 performed on the Guide Book. Unlike prior art user interfaces, the way a user gets help for
14 performing a function and the way the user performs the function are the same. To
15 perform a function and to get help for a function, the user simply activates a link.

16 **Concluding Remarks**

17 The foregoing has described a user interface architecture based on documents-with-
18 links that facilitates creation of user interfaces that allow users to read, annotate,
19 collaborate and perform other tasks typical of knowledge work, as well as alter the
20 interface to best suit their work patterns. It will be appreciated that many modifications
21 and variations of the invention are possible, and the specific examples and descriptions
22 herein do not limit the scope of the invention.